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HOW YOU BEGAN

A CHILD'S INTRODUCTION TO BIOLOGY

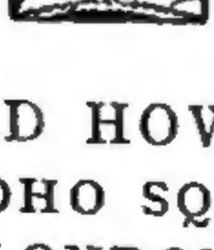
by

AMABEL WILLIAMS-ELLIS

with Prefaces by

J. B. S. HALDANE

READER IN BIOCHEMISTRY IN
THE UNIVERSITY OF CAMBRIDGE



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PREFACE FOR GROWN-UPS

THIS BOOK HAS made me very angry, not with its authoress, but with the remainder of the human race, and particularly the biologists, including myself, who did not write it. For it is the only book of its kind, so far as I know—which is a scandal. If every child in Britain were to read this book, their average expectation of life would probably be increased by about a year, for hygiene is applied biology, and you cannot act hygienically if you have not learned to think biologically.

As this book is the first of its kind, I should have to commend it even if it were rather bad, just as I should commend an animal which learned to live at the South Pole, even if it was rather a poor sort of animal otherwise. As a matter of fact, however, the account of evolution given by Mrs Ellis strikes me as being more nearly correct than either of those two recently published by well-known scientific men.

There are, of course, things that I should have put differently, and I should have stressed certain embryological facts which Mrs Ellis has omitted. But then no child would have read my book.

There are one or two ideas in the book which might well appeal to a grown-up biologist. For instance, it is a very good account of embryology to say that we spend the first six months of our lives in playing at being extinct animals. For there is a certain lack of seriousness about the changes in bodily form which we undergo. Our gills are not very good gills, for example. We play at being fish, but it is only play. We are inadequate fish at four weeks, just as we are inadequate savages at nine years.

The opinion is widely spread that biology is unsuitable for young children. I do not agree with it. I knew the differences between the main types of animal, and the names of most of my bones, when I was seven, long before I knew any but common-sense physics or chemistry. And, in my limited experience, children find it just as easy to understand simple things about animals as about machines.

I hope that this book will run into many editions, in which its authoress will answer some of the questions which I should have asked if I had been lucky enough to read it as a child. If so, she may be encouraged to write the badly needed sequel, namely, *How you work*. I believe that she could do it, and I do not know of anyone else who could. If she is to be encouraged to do so, you should not only buy this book for your children, but induce your friends to do the same.

J. B. S. HALDANE

DUNN INSTITUTE OF BIOCHEMISTRY
CAMBRIDGE UNIVERSITY
May 1928

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The frontispiece and illustrations on pages 25, 53, 59 and 73 are by MARY ADSHEAD.

PREFACE FOR CHILDREN

I THINK THIS is a good book. I know of no book like it. All girls and boys should know how they grew. I did not know this when I was quite young. How I wish I had. But there was no book like this then. I wish there had been. I have to teach people who are going to be doctors. I should find it much easier if they had read a book like this when they were children. Besides it is such fun to know that you once played at being a fish, and later had fur. How I wish I had kept my gills and my fur coat. Then I should not have to dress nor to learn how to swim. And I am sad I have lost my nice tail. And this book tells how some of the children's children of long-ago animals became dogs, and some fish, and others men. So the animals are really our cousins, and that is why we should be kind to them. The story of how we began is really the most exciting story in the world, and this is only a

little bit of it. The full story is very long and difficult, but the parts in this book are quite easy, and I hope you will like them. Then when you are big you can learn the rest.

J. B. S. HALDANE

PLEASE READ THIS

DEAR CHILD,

I think you will like this book best if you read straight through it as far as the Extra Chapter of Questions. Don't read that, and don't bother about the things that you haven't quite understood, or that you want to hear more about. Then read it through again, and this time read the Extra Chapter at the end.

It is rather easy to get muddled in a book like this which has a little about a lot of things in it. If you ask all the questions that you think of just *when* you think of them, you may get tangled up. But a book is a nice thing—it will always wait, and (if it can at all) it will answer your questions another time. It is not like a person, who may not be there next time, or may be too busy.

It may seem queer to you not to put all I can about each thing in the chapters as they

come ; but I was so afraid of being muddling. So I have put extra things in the Extra Chapter. Perhaps you will ask questions as you read this, that I have not answered even in the Extra Chapter. That will be for one of four reasons : One will be that I did not think of the same question as you, and so never thought of answering it. Another will be that I did not know the answer myself. Another will be that the answer is too difficult and muddling for you. A fourth reason will be that nobody knows the answer.

For when you learn about how living creatures like you, or a fish, or a cat, are made, you quite soon get to the edge of what people know. But perhaps by the time you grow up, you, or somebody else, will have found out all the answers to all the questions you can think of. I don't think they will. But I hope they will find out quite a lot more.

One other thing—this book is really in two parts. One part is about the quick way in which each child grows, and one part (which is printed with a ❦ in the large space at the side) is about the slow way all the animals of the earth have grown. So when you are tired of reading it

straight through, it might be fun to read each of those parts separately. But don't do this the first time, or the book will seem dull.

Good-bye,

AMABEL WILLIAMS-ELLIS

HOW YOU BEGAN

CHAPTER I

I

YOU WERE ONCE a little tiny speck of jelly. This was long before you became a baby or were born. You had no hands, or feet, or arms, or legs, or head.

You had no mouth, or eyes; you were far smaller than a pin's head, quite soft, and no shape in particular.

You did not like anything, or hate anything, or feel glad or sorry.

Only you always meant to grow. Growing was a thing you somehow had to do.

You know when a person is asleep in bed, if the sheet or blanket gets pulled over their nose so that they can't breathe, they wriggle or push it away without waking up.

Well, that was just the way in which you wanted to grow. You had to grow, just as the person who is asleep has to breathe. Wanting to grow is so strong that a plant will move

away a stone that stops it from pushing out of the ground.

But for a long time you, the little speck of jelly, went on growing without waking up, just as a person goes on quietly breathing all night.

2

Once, long ago, there were no proper animals, or fishes, or insects, in the world, except little spots of jelly far smaller than pins' heads, and not nearly so tidy and round. There were no creatures in the world except this kind, which was just like you when you began.

They were called pro-to-zo-a, and they floated about in the water. It must have been very queer, for these little creatures had no eyes, or arms, or legs, or even flippers or suckers. They could not move about properly or even stay still, but just floated where the winds, or the tides, or the streams, took them. If the water was quite still, they could get along a tiny bit by a sort of rolling and stretching, but if the water moved, it carried thousands of these tiny things along. They could do nothing to stop themselves. They could live in salt or fresh water, and they ate

little tiny bits of sea weed or pond weed that got broken off the weeds that were growing, or else tiny green plants that floated about just as they did. But they could not see, and they could not swim, so they had to wait till they happened to float near to a scrap of food. When that happened, the tiny jelly creature opened itself anywhere and swallowed the food.

It had no special mouth and no special stomach, because it was like a bit of plasticine that you can dent in anywhere and wrap round a nut or a small marble. It is rather fun to do this: then you will know how the first creatures in the world ate their meals. But the first jelly creature was ever so much smaller than your bit of plasticine, and later on you will find out why it had to be so small.

But, as you will have guessed, very often the protozoa didn't happen to bump into a bit of food. Sometimes the tide or the stream floated them up on to the land and left them there, high and dry on the beach or the bank. Then there was nothing to float in. So when they had eaten anything that they happened to be touching, they got no more food.

Bits of food were often quite close in the water or on the land. If only the protozoa could have seen or smelt a little, and swum or wriggled a little, they could have got the food. But they couldn't.

So then they died.

Heaps and heaps of protozoa died because they couldn't see, or swim, or wriggle, even an inch to get at a crumb of food. It was great waste of protozoa. This waste went on for thousands and thousands of years and it goes on still, for there are plenty of protozoa still alive.

3

Now this jelly creature, like everything else that is alive, wanted to live and to grow. It did not want, in the way you might want a book, or want a toy, or want to go out. It wanted, as you want to breathe—must breathe—when you are asleep. The protozoa wanted slowly, and wanted all the time, just as you wanted to grow when you were a little jelly creature, like the first live creature that ever was on the earth.

There was one great difference, though, between you and the first live creatures.

It took thousands and millions of pro-

tozoa one after the other, living for millions of years, to grow, ever so gradually, little by little, eyes to see, or noses to smell their food with, and to grow flippers or fins to get to it. Some of them never learnt, and so there are plenty of these tiny jelly creatures still in ponds and in the sea. The bother is that they are so small that they are difficult to see. You would have to use a very strong microscope, and that is difficult till you are grown up.

But there are heaps of them in nearly all shallow water, especially in pond water. They are no colour, and really if you look at a frog's egg, it is very like looking at the first creatures down a microscope, except that the frog's egg is neater and rounder.

But the little bit of jelly that was you, seemed to know in a sort of way what it was doing, and you didn't stay plain jelly for more than about a week.

A good book to understand the actual meaning of Biology. This book may prove fruitfull rather for Children

CHAPTER II

I

YOU GREW—you grew in a special way, not like stretching a bit of elastic or blowing up a balloon. There seems to be only one size for jelly lumps and they never get big. Instead of growing the little jelly began to divide. Then each half jelly grew to be as big as the first tiny jelly. Then each of the new ones divided again and so on and so on. One, two, four, eight, sixteen, thirty-two, and so on.

It was like this:

SEGMENTING CELLS

But still you were very small and no particular shape.

Then as you grew you began to change. The little jelly-lumps out of which you were made, seemed not to be just themselves and all exactly alike, but they all seemed to be part of something. There seemed to be an inside part of this something, and a middle part, and an outside part.

Then instead of being a sort of roundy, no particular shape, you got long, and then a sort of dent seemed to come all down you and you began to fold. This was a great change! You really had done something. Now, at the end of about a fortnight, you were a fairly long-shaped, hollow tube of jelly. You were still very tiny and you had no arms or legs or head, and you were still made of tiny little jelly lumps (which are called cells) just as a wall is made of bricks or stones.

Each little bit of you was still growing on its own, and there wasn't much difference between one part of you and another.

There are creatures that stay like this. There are some sorts of worm that are really grander, and can do much more than you could then, but in a way they are the

same. For instance, if you cut them in two each bit goes on. There are two short worms instead of one long one. I suppose it hurts, but not nearly as much as it would hurt an animal like a rabbit or a cat, which would be killed. But with a worm there isn't one bit which is the worm and one bit which isn't, as there would be if a man's legs were cut off or a kangaroo's tail. A man could live without his legs, and a kangaroo without her tail, but his legs couldn't live without him, nor could her tail.

And, as you know very well, it would be the same if a dog or a cat were run over and bits of them got cut off. There are bits of a cat or a man that are stupid, and no good without the rest. They are very useful to the cat or man for clawing, or climbing, or waving, or holding tea-cups. But they are not the cat or the man, and cannot live without the cat's brain, or the man's brain, to tell them when to wave, and what to hold.

But many sorts of worm are the same all over. None of a worm of these kinds is very clever or can hear, or run, or think well. But all of it can wriggle along a bit, and will do it quite nicely even if it is cut in half.

2

When you had been growing for about a fortnight, you were like a very short fat worm made of a kind of jelly. By now you were nearly as big as a pea.

☘ All baby animals grow like that. And with some animals you can see part of it happen.

Newts and frogs lay jelly eggs in the water on the edges of ponds. You can see all this happening fairly well before the eggs turn into tadpoles. You can't see the separate cells, they are too small, but you can see that parts of the jelly are turning into different parts of the tadpole.

However, when you had turned into a sort of short fat lumpy worm it didn't seem that it was enough.

A worm was not a very interesting creature to be. Somehow you knew that wasn't the sort of animal you were meant to grow into. So you went on.

3

And now tiny bits began to grow and push out ; there was one at the top end of the worm, and two at the other end, and two at the sides.

What were they going to be? You didn't really know.

But after about another week it was quite certain that the top one was turning into a head.

Whose head? Your head.

Yes, but was it a caterpillar's head or a fish's head?

That wasn't very easy to say. It was big for your size and very much bent down, and two eyes seemed to be going to grow in it.

What about the rest of you? Had anything else happened to help a guess at what you were turning into?

It had.

4

Do you remember that you had folded, and were fairly hollow inside? Well, it was plain that the hollow was going to be some creature's tummy, and where the fold had come, you were growing harder. There was a hollow stick of soft bone growing all down you.

Well, that little soft stick settled one or two things.

You were not going to be a slug, or a worm, because you had got a proper head.

You were not going to turn into a crab, or a lobster, or a starfish, or a spider, because you had begun to grow a backbone.

☘ None of those creatures have any backbone. Crabs and lobsters wear all their bones outside them instead of inside (like us, and rabbits, and all the furry and feathery creatures).

As for real jellyfish, and worms, and slugs, they don't have any bones at all. That must be a great bother unless you are very small. Bones are most useful whether you wear them inside like a cat, or outside like a crab.

How difficult it would be to do anything if your arms and legs, or your back, had no bones in them! Your arms would only be like bits of rope, all floppy—and so would your legs—they would be no good to walk on, and you, if you had no backbone, would be like a pillow and would have to sit still in a heap.

5

But even when you had grown a backbone, there are lots of things that you seemed as if you might be going to turn into.

For one thing, at the end of four weeks you had got a tail!

Were you going to be a lamb, or a pig, or a walrus? Those little short bits that stuck out

might have all been going to turn into legs, with hoofs at the end, or into paws or into flippers. Nothing seemed at all decided, except that you did not seem very much like a person, especially as you had that short neat tail.

Or of course you might have been going to turn into a fish. In fact, that seemed a very likely idea indeed. Those little leggy things would do nicely for fins.

❧ Besides, there was one thing about you that made it seem that a fish was much the most likely thing for you to grow into.

For what is the difference between a fish and a land beast?

There are several differences, of course. But if we think even of fish and land beasts that are very much like each other, there is one big difference. Think of an eel and a snake. They are rather alike. But an eel breathes under water, while a snake is like us. It drowns if you keep it under water too long. It has got a nose and lungs, and a nose and lungs are no good whatever for breathing under water. An under-water creature must have gills.

Well, you began to grow slits in your neck ready for gills. For at least a fortnight you

seriously set to work to grow gills as though you were going to be a fish. There were other things about you that were like a fish, too. One was your heart.

6

Nowadays, like other land animals (horses, or sheep, or anything else), you have quite a grand heart, to pump the blood through your veins. It is about heart-shaped and as big as your two fists. It has grand tubes leading to it called veins, and grand tubes leading away from it called arteries, and it has four parts to it—some of them with doors between—all as grand as can be.

Without thinking about it, you keep squeezing up first one part of your heart and then another, about every second. One squeeze pumps fresh clean blood round to places like your toes and your head (to feed them), and the other squeeze pumps used dirty blood to your lungs to be cleaned. It is all very grand and well arranged, with different parts of your heart for doing different things.

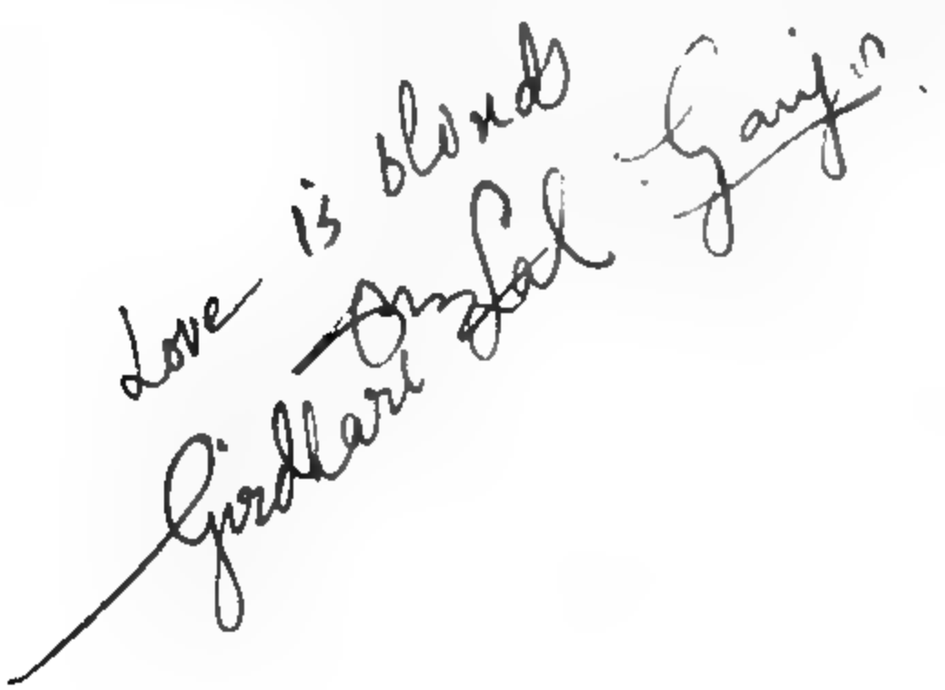
☘ But a fish just has two or three long veins for the blood, and in one of the veins (which is a tube rather like a thin

bit of rubber piping) there is a swelled-out bit. And the fish (without thinking) squeezes this, and just pushes the blood along.

Well, in those days your heart was just like that. It was only a swelled-out bit of vein with no different parts, except doors to prevent the blood going altogether the wrong way.

So, what with a heart like that, and gills to breathe under water with, and a tail, do you think it seemed much as if you would turn into a person?

In the next chapter you shall hear how other jelly creatures long ago thought of turning into fish, and how long it took, and what a lot had to be done.



CHAPTER III

I

IT TOOK YOU only about three weeks to change from a tiny jelly creature into something that might be going to be a fish, because in a way (I want to explain this part properly later) all your funny ideas about what you would be, were only a sort of acting or game.

You played this game all alone in your sleep. This was before you began slowly to yawn, and stretch, and wake up enough to be born, and then yawn, and stretch again, and wake up enough to begin to listen and look, and to be glad and sorry.

In all these changes that you went through you were only copying what had been done before by tiny jelly creatures, long, long ago, when the earth was quite different from what it is now. They had taken a long time (several hundred million years or so people think) and it had been difficult.

Then, in that far away time, the earth had different seas and different land. Only the sun and the moon were about the same. Even the stars were in different patterns then. Being alive at all (instead of being a rock or some water) was a very new and a very queer idea.

The way in which protozoa began to grow into something else, seems to have been like this.

You remember that the floating jelly creature was made out of a jelly lump (called a cell) like this:

just as you were. Then, how it, like you, began to grow, by the cells dividing and turning into two small cells and then these growing, and so on? At first when one cell turned into two cells, they split and then separated so there were two small protozoa. But sometimes the cells divided without splitting, and then there were a bunch of cells growing together. This was the beginning of the plain jelly turning into a new sort of creature.

The first beginning of the change was

when some of the cells took to doing different parts of the work.

For instance, people think that the first change that happened was, that the cells on the outside of the bunch got a bit harder than the others, so that they kept out the water and dirt better, and so that bumping didn't spoil them so much or break them off.

Then, when that was done, some of the cells on the inside got time to get better at melting up the bits of food. Then the creature found that it could manage hard bits that had been no use before.

That would be the beginning of a jelly creature, that was made of several cells, getting a skin and a tummy.

2

The creatures that had a skin and a tummy, did not die so easily as the ones with several cells but where all the cells did all the work. They did not get hurt so much by bumping into things, and they could use more of the food.

Then one day perhaps, two or three creatures grew, that had one or two skin

cells that stuck out a little. Perhaps this was because they had got a little hurt or perhaps it just happened like that. Then those skin cells grew.

At last, the children's children's children of one had tiny flippers perhaps, and the children's children's children of another had suckers, and the children's children's children of another had learned to pick up tiny bits of sand and make them into a useful shell.

3

Anyhow, after a good many hundred thousand years there seem to have been quite a lot of different jelly creatures. Some were just the same as ever and made of just one tiny floating cell. Some, though they had several cells, still had all their cells the same. They could not swim, or see, they had nothing to protect them if they bumped into things.

But some had got just a skin and stomach, and a mouth in the skin to get to the stomach.

Some had got sticking-out bits of skin.

Some had got sticking-out skin that had turned into flippers.

Some had skin that had picked up sand and turned into a sort of shell.

Some had sticking-out skin that had turned into suckers.

Some had skin that had turned into a sort of nose, so that they could smell what water had bits of food in it. This kind of nose, as a matter of fact, seems to have been one of the very first things to have grown.

At first the protozoa had not got any eyes. Some people think that it was a very weak jelly creature that first learnt to have eyes. The light hurt its back and worried some of the cells of its skin. It had children who were more worried still, and *its* children could hardly think of anything but the light, and light seemed nearly as important as food. And the light worried them till they grew eyes to see it with.

I don't know if that is true, but I think that something like that must often have happened.

I mean, that I don't think it was always the strong and clever ones that thought of the new ideas. It very often was: but sometimes I think it was the rather weak ones that were born a bit wrong. They

had to do something about whatever was worrying them or else they would die. So often in the end they got better than the ones that were born ordinary.

There are so very many hundreds and thousands of different creatures, with different ideas of how to do different things in the world, so many, that I think weak ones as well as strong ones must have helped.

For instance, suppose two jelly creatures were tired of floating and banging about. The strong one's child and grand-child and great, great, great grand-child would gradually grow beautiful long fins and a tail to steer with, and become a tiny fish. The weak one's child would grow suckers, to hang on to the rocks with, and perhaps a shell as well, and lead a very quiet life and be an oyster.

Anyhow, we do know two things for certain. First, that it took a very long time, perhaps fifty million years, perhaps more, to get from the first live creatures with only one cell, to a regular little fish with bones, and scales, and veins for blood, and a stomach for digesting, and eyes to see with, and gills to breathe in water with, and beautiful colours on its scales.

The other thing that seems quite certain is this. There were fish before there were any land animals. So that you, when you rather seemed as if you might be a fish, were doing just what all the creatures in the beginning of the world did. It had once been grim earnest, where lots of creatures died because they changed too quickly or not quickly enough. For most creatures did not live long enough to help in this queer work of changing. Millions and millions never changed at all. Millions and millions changed backwards, and forgot how to grow shells or suckers or fins.

So that only a few creatures of all the millions alive in any hundred years, managed to grow up and have children and pass on to them the changes that have got us and all the other animals to where we are now.

But you were just acting the real story over to yourself in a kind of play, where everything went right.

CHAPTER IV

I

WE SAID AT the end of Chapter II that when you had been growing for four weeks you did not seem very likely to become a person because of your tail and your gills.

You had not got real eyes or ears, and there was not much difference between your head, and your neck, and your body. Your arms and legs were getting on, though.

By the end of another week your arms and legs would bend in the middle where your knees and elbows are now. You were growing a nose and lungs, too, but you could not bear quite yet to throw away your gills, but kept them a little longer as if they might come in useful.

You had not got proper nostrils, though, but only dents that did not lead anywhere.

Your eyes were fairly big, but only made of a sort of puckered skin. There was no beautiful hard eyeball, with lids and lashes and pretty colours. You grew these afterwards.

At that time, when you had been growing for about five weeks, you might quite easily have been mistaken for a pig at the same age—not for a grown-up pig, of course.

You had got only one lot of joints in your arms or legs, which were still very short.

All your bones were still soft. Your backbone was the best.

There still seemed quite a chance that your arms and legs would turn into flippers, and you be a seal, and swim in the sea, and flop about on the rocks, and have beautiful long whiskers.

Still, it was clear you were not going to be a fish, because of your nose and your lungs.

Your tummy and heart were getting on, too.

Nowadays you have a very grand tummy, with all sorts of pipes and tubes in it, and a regular factory going on of all sorts of things that you need—it is much grander than a fish's inside, but still quite like a pig's or a seal's tummy.

2

And now, what were you like after you had grown for about eight weeks?

You were still extremely small for one thing, not much bigger than a big horse-chestnut.

But you had decided some more things.

You were not going to have hoofs. Your tail had not quite disappeared ; but you had begun to have fingers and toes.

So now you were not going to be a goat or a seal or a sheep or a deer ; but something either with paws, or with hands and feet.

By now you had got eyelids, and a short nose.

3

I wonder if you have thought of a thing which your body remembered had to be done ? The jelly creature long, long ago had had to see about it almost as soon as some of its cells learned to do one sort of work and some another.

It was this. You needed telegraph wires.

You see, when the outer cells of the jelly creature turned into skin, and the inner cells turned into a tummy, very often messages had to be sent between the two. Tummy wanted more to eat, and wanted the outer part, and the sticking-out bits of the skin (which had grown into flippers or suckers), to try and get it some.

So a sort of feeling came through from tummy to skin, that skin and flippers had better get busy. 'All right,' said the

flippers, 'we'll swim, but first give us some of that food you've got ready digested, to make us strong.' So the tummy did. The flippers swam—some food was found: then the outer part told tummy to get ready to digest, and quickly swallowed it up.

Gradually the part through which these feelings or messages came, got very good at passing on the news.

Do you remember that we said that eyes grew, and ears and smelling parts, in the skin? Well, when these things happened there were more and more messages—seeing messages, smell messages, and hearing messages. Some cells found that they were better at messages and at choosing what ought to be done, than the others.

So, when living creatures got to be as grand as fishes, with all the different parts of them specially good at doing different things, we find that there is a whole kind of post office working, and a special thinking choosing part as well. The thinking choosing part is called the brain, as you know. The message parts (which are like long white threads) are called the

nerves, and they work rather like telegraph or telephone wires.

Even the very simple worms that can be cut in half, and that we talked about before, have a few of these telegraph wires, though they have no special thinking and choosing part. If they had, of course they could not live if they were cut in half. As soon as there are nerve threads and brain, then all the taking of messages and the thinking are done by them.

You see, when one part starts specially thinking, the other part will say, 'Why should I do this, too? It is waste of time for us both to do it.' So the other bits leave off thinking and choosing altogether.

That is always the way with living things. They forget how to do any work that they don't often do. Which is a good thing, because then they can spend all their time doing their special work. You can't think with your toes, nor can a cat nor a crocodile think with its tail.

Now when you had been growing about eight weeks, you had begun to be very busy growing nerves, because you had now got all

sorts of separate bits—skin, tummy, paws, eyes, nose, and so on—so there would soon be a lot of messages to send.

Now, as you can guess, it is a very good thing to have the telegraphs kept very safe. For instance, if something went wrong with your telegraph system you would not know that your toe or your finger was being burnt, or nibbled by a rat, and that you must quickly pull your hand or toe away.

So, though most of your body is outside your bones, the two most important parts of your thinking and telegraph arrangements, are carefully kept inside your bones, like the whole of a crab.

Your brain is inside your skull, and the chief telegraph wires go down in the tube inside your backbone.

4

So now, in every little bit of you, thin, delicate white threads were beginning to grow, and to join together, and to reach along, either straight to your brain or to the big nerves inside your backbone :

Nerves for smelling.

Nerves for feeling hot and cold.

Nerves for hearing.

Nerves for feeling whether what your hand was touching was hard or soft.

Nerves for tasting.

Nerves for seeing.

These nerves take messages from all the different bits of you, and tell your brain what is going on.

Another lot of nerves, from your brain to the different bits of you, tell your toe or your hand what to do about it.

Smell nerve says to the dog: 'There's a delicious bit of meat close to me,' and quick as winking, brain flashes back to teeth, tongue and throat: 'Snap it up and swallow it!'

If you have got a dog you will see how quick that can be done. You can do it pretty quick yourself.

Or try another thing—to see how well the telegraphs work. Shut your eyes, and let somebody prick you gently with the point of a pin. You will feel the prick and can pull your hand away before the other person can count up to one.

By the way, the place where the person pricks you makes a small difference. You feel a little quicker with your toes or fingers than with your leg or back. This is because your toes and fingers have the most nerves.

5

Fish's brains and nerves are very quick at this sort of thing, and so are birds'. But there were once animals in the world, very large ones; some were called dinosaurs, some iguanodons, and so on. They were simply enormous—some of them were as big as a cottage, far huger than elephants, as big as the biggest whale. Now these big creatures had tiny brains. They only understood very slowly what was happening to the tips of their tails or other far away parts of them. Even when they found out, their brains were so small and feeble that they were very stupid at deciding what to do, and when they had decided, they did it very slowly.

They ate grass and leaves, and if there was no grass and leaves in the places where they were used to finding them, then they were too slow and stupid to find them in other places. And so they died. Sometimes this was because they were too slow to find their food, sometimes because smaller, cleverer creatures had got there first and had eaten it all up. Sometimes they tried to fight the small quick creatures.

But then other small quick creatures—tigers, wolves, and so on—learned to eat them.

So there are no more very big, very stupid creatures. Very stupid creatures have gone on living all right, but they are quite small, like oysters and mussels and slugs and worms, and spend a great deal of their time hiding or holding on tight to rocks.

The good-sized creatures that have been able to go on living have been the ones that were clever and quick. Just being very large, and heavy, and strong, was no good, if you were very slow and stupid.

There is no time to tell you in this little book about the cleverness of a great many animals that are alive to-day. But you yourself can easily think of them.

You will think of birds that build nests, and fly far away to foreign countries when it is winter in the country where they were born.

You will think of dogs and of wolves that hunt all together and can smell their food from far away.

You will think of sharp-eyed eagles,

and gulls that fly so high and strike so suddenly.

You will think of beavers that make dams and houses for themselves, and of gazelles and rabbits that have one gazelle or one rabbit, always watching when the rest feed, in case an enemy comes along.

And you will think of bears that live in snowy countries and sleep all the winter, and of wise monkeys and elephants.

For now all the strong, heavy dinosaurs, and the flying lizards with their frightful teeth, and their wings like bats, are dead, and all their children are dead. But the sly fox, and the leopard that leaps as quick as fire, and the wise squirrel that lays up nuts for the winter, they are alive and their children's children. And so is man. For man is the wisest of all creatures, and there is no beast, nor heat, nor cold, that can conquer man.

6

So you busily grew your brain. For that was more use to you than teeth or claws or wings.

Even the brain of a baby chicken before it comes out of the egg is rather big, though hens

are not very clever creatures. Its head is nearly as big as the rest of its body at one part of the time. But as for *your* head, it was immense.

Your brain, and that of all the clever animals, is arranged in a very good way. This plan saves you a lot of time. Your brain is divided into two parts. You can use one half of your brain for real thinking and choosing. The other part does the easier work, so that the real thinking part is not bothered with it. This is true about humans and all the cleverer animals. I will try and explain how this works.

For instance, suppose your cat is walking in the garden. We will pretend that she has just had a saucer of milk, also that she is a mother cat, and has got a kitten.

As your cat walks in the garden, the two bits of her brain are both working hard. The bit of her brain that works of itself is quietly working her tummy and making it digest the milk she has just had. It is seeing that it is being turned into blood and bone and that she is being kept warm with it. Her brain is also moving her ribs as she breathes, and her four paws as she walks delicately over the

grass. It is also probably gently twitching the very tip of her tail.

But the real thinking and choosing part of your cat's brain is not bothered by all these things. That is busy with real thinking. She is thinking, we will pretend, that altogether too many people have come to see her new kitten in its box in the kitchen, and that she will carry it out by the scruff of its neck and choose a quiet new place for it in the potting-shed.

It is just the same with you, and a very good thing, too. Your real 'You,' your thinking choosing brain, is not bothered by all the difficult things that your body has to be doing all the time. So you often do two or three things at once, without it being in the least bothering—you walk about, whistle a tune, digest your breakfast, and all the time you can be thinking about whatever you like, about this book you have just been reading, about a story that someone has told you, or about something that you mean to make.

CHAPTER V

I

BY THE TIME you had been growing for about four months, you were about as big as a kitten that has just got its eyes open. Now there were only two things that you might be going to be. Would you be an ape, or would you be a person? That was the question.

You had got hands and feet, and no tail, and your legs did not seem as if they were meant for very fast running. You would do some walking and some climbing most probably. You had not got strong jaw-bones for snapping and crunching like a wolf or a bear. To have really strong jaws you must have a long-shaped, not a round head. But your head was round and your face was fairly flat. Your nose was short, and it was plain that it was not going to be as good for smelling as a dog's.

But your brain was big, like an ape's or a man's.

It took a long time for any animal to grow in the world that was as clever as an

ape. But all the time (after the idea of being very strong but very stupid had been found to be such a bad idea), the animals of the earth did come to have bigger and bigger brains for their size.

So when you had grown for five or six months, it was quite plain that you, with your big brain, were one of the later kinds of animals. In fact, except for one thing, it was pretty certain that you were going to be a person. Do you know what that one thing was?

You had a very neat coat of fine fluffy fur all over.

And do you know that you only really absolutely stopped playing at other creatures, and decided to be a person, quite a short time before you were born? At any rate you only shed that coat of hair when, at last, in every other way, you were a real baby.

But when you had been growing for eight months you were a baby. You had finished all your strange dreaming, and your playing at the history of all the life of the whole world.

Now you were a person, a boy or a girl. You had left worm, and fish, and pig, and dog and ape, far away.

And now in a month it would be time for

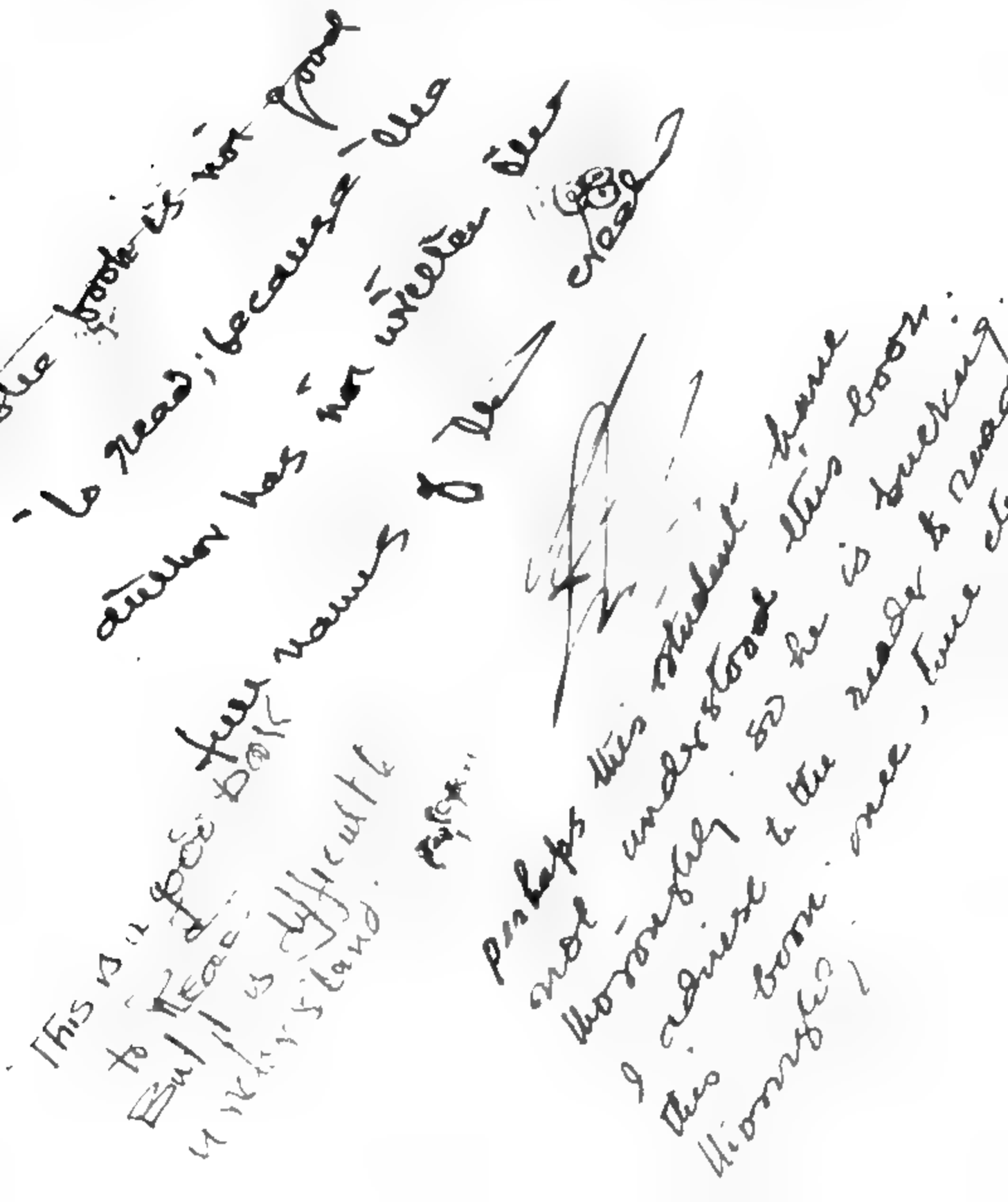
you to be born, and it will soon be time to end this book, because you know the rest of the story. But there are still a few things to be told about you.

2

I wonder if you have noticed one thing? That all this time I have not said a word about where you were. And to explain this and why it was, I want to go right back to where we started.

❧ We said that heaps and heaps of protozoa died because they could not see or move. We said that to grow each of the things that you have got, a skin, bones, sight and smell, and nerves and a brain, had taken years and years of trying and failing and trying again and failing again. Many, many millions of creatures died of starvation, or of the cold, or were eaten, before these things were got to work properly. For being a new kind of animal that was not quite finished, was generally more dangerous than being an old sort that did work fairly well. So it took a long time and many deaths. Many kinds of creature died out altogether, whole nations of creatures died.

But you grew and changed every week or two, quite smoothly and gently. You were not too cold or too hot: you were quite safe. The whole dangerous changing that had taken hundreds of millions of years, and for which millions upon millions of creatures had died, only took you eight or nine months.



CHAPTER VI

I

WELL, YOU MUST know that all the while that creatures were learning to be clever at living in the world, and at getting their food, and at running away from their enemies, or else at fighting them, they were also learning another thing. They were learning how to take better care of their children.

For when there were more and more parts, like skin and bones, and nerves, and so on, to grow, and many different kinds of cell to make, it took longer and longer before a new creature could be like its father and mother. And all the time, till it could grow like them, it was very blind and stupid and helpless, and easily killed either by bad weather or enemies.

We said some creatures thought it was best to swim, some learned to walk, and some grew suckers and stayed still. It was like that with their ideas about how

best to make sure that enough baby creatures should grow up.

Different creatures had different ways. No end of different ways. Fishes and frogs, for instance, just laid hundreds and hundreds of jelly eggs in the water. It did not matter if most of them were eaten or dried up by the sun. There were such a lot that some were sure to live to grow up. That was one way.

But the creatures that became birds thought of quite a different way. For one thing there was more for a baby bird to grow into and learn and do, than for a baby fish or frog.

So birds began to lay quite large eggs. The tiny jelly egg from which the chick really grows, is just as small. All the rest of the egg is food for the little growing chick. Then outside the food and jelly egg, the hen grows a shell, to keep out the wet and dirt, and last of all she lays it.

Then besides that, the father and mother birds generally build a nest and put the eggs in that. Then either the mother, or both the birds in turns, sit on the eggs to keep them warm, and then, when the chicks are hatched, the parents feed them.

So with all that care, a great many baby birds live to grow up, and there is not half the waste of baby birds as of young fish or frogs. For fishes and frogs have hardly any food stored up for them, and their parents do not care about them in the least.

2

But the furry animals had another way again. You see, there was always some difficulty, and there was one great bother about eggs. One of the two birds had to sit on them to keep them warm all the time till they were hatched. Then, if there were enemies about, either the poor mother got killed if she was found when she was sitting on her eggs, or else she had to fly away and leave them. She could not take them with her.

Well, then, the next idea—the idea the furry creatures had—was that the safest place for babies, while they were still very helpless, was inside the mother. Then she could run away if enemies came, and also move about and get food. Her blood could feed the baby creature, and the warmth of her body could keep it warm.

So lambs are not born till they have got

a nice suit of wool to protect them, and long legs to run with. It is the same with horses, or donkeys, and zebras, or goats. A few hours after they are born they can run quite nicely, and their mothers can move about, cropping the grass, and the babies can follow. In a few days, if an enemy comes, the young ones can run away almost as well as their mothers.

But that is not the only care that the mother takes of baby animals. She gives them milk for quite a long while. I expect you have seen a mother pig, or cat, or dog, or sheep, or cow, give milk to her young ones.

And there is another thing. Fish and most frogs do not love their children at all. But nearly all feathered and furred animals do, and so do humans. And so the children of these creatures do not die like the frogs and fish.

First the mother has the child growing safe and warm in her body, then, when it is born, she gives it milk and loves it. Then she teaches it.

And all this her mother did for her, and if the baby is a girl, the baby will do the same

for her children. If it is a boy, say in a savage tribe, he will do the taking care and teaching of the children as well, he will fight the baby's enemies and bring food to the mother. If he is a white boy he will work for the child and the mother.

And it was because your mother and father did all that for you that you were able to grow in peace, from being a speck of jelly, to being a child with hair and teeth and all kinds of cleverness.

3

CONCLUSION

I used to think when I was a child, and now children often say to me: 'Oh, I wish I was strong like a lion,' or 'I wish I could run like a greyhound or climb like a monkey.' But now I, anyhow, am glad that I grew into a person, for now I believe that men and women are the strongest and cunningest of all animals, and that a big brain and a clever hand are better worth having than all the strength, and speed, and beauty of the other animals.

Think how people live, even people like Red Indians, and still more white people.

For what happens is that the man, though he cannot run fast, catches and tames a horse. The horse runs for him.

The man cannot bite hard, nor smell out a rabbit, but he catches a dog and makes it love him, and the dog bites and smells for the man.

A man is not quick enough to catch a mouse, but he catches a cat and makes friends with it. He has not got nice warm fur, but he catches a sheep, clips off the sheep's wool and spins and knits it into clothes.

Even the strong elephant must do what his master says and pile up logs for him. Floods come, or the sun burns up the grass, or the winter frosts come, and the ground is frozen hard and the poor rabbits and birds die in their holes or on the branches. But man has stored up food, built a house and lit a fire. He has built a boat, and fetches the fish out of the waters to feed his children and his cat.

And now he has fetched the iron out of the earth, and oil to burn, and he has learned to make the steam work for him. And with the oil or the steam he goes faster than the deer or the ostrich, and he flies like the eagle or the albatross.

All the other animals walk the earth in fear of enemies, or of starvation. They walk with

[illegible]

[illegible]
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AN EXTRA CHAPTER

I

THAT WAS REALLY the end of the story of how you began. But when that story was told to some children, some of them asked questions.

So as there was room in the book, I thought it would be a good plan to put in an extra chapter.

There is one question that used to puzzle me very much and may puzzle you. I don't think there is quite a whole answer to it. But if you don't count things like birds with coal scuttles on their heads, such as hornbills, or cocks with tail feathers as long as a man, or a few queer creatures like that, there is quite an interesting answer.

It is a long question and a long answer. The question is this :

Why is it that now there are such hundreds and thousands of quite different creatures in the world ?

For there are flamingos, and cats, and

humming-birds, and us, and octopuses, and porcupines, and zebras, and cockles and mussels, and kangaroos, and crocodiles. Besides these, there are also trees, and grass, and bees, and ants, and whole nations of creatures that are too small to see but that are quite alive. There are also germs : some of which are good to us and the other big creatures, and some of which are bad.

We have not had a word in this book about any of these millions of interesting creatures, but have just kept to the jellies and the beasts whose children's children's children turned into people.

You would have thought that there *ought* to be one way that was much the best way of getting at your food, and of keeping alive so that you could grow and have children.

But what you *find* is that there are still simple jelly creatures alive, all safe. They are in the earth, in the sea, in ponds and rivers everywhere. There are far more of them than of us. They have not learned even to grow the slightest flipper, let alone a brain. And there they are. Their life may seem dull to us, but they are alive all right, which is all *they* want.

Then there are thousands of sorts of little creatures (especially in the sea) that are just a

little cleverer than protozoa, and can swim a bit, but are not as clever as a fish. Whales eat a million of these sorts of creatures every time they eat a mouthful. These creatures get on all right.

Then skip—skip to mice, they get on all right. Then take a smaller skip to grand and special creatures like apes and people. We get on all right.

So does grass, and so do germs which are too small for any regular animal to see.

Why should there be so many different sorts? How did it happen?

That is the question that used to puzzle me, and to which there seems to me even now to be only half a proper answer. The half-answer is this.

Living creatures are very complicated—they even sound complicated in this book, but I have missed out nearly as much as I put in, so as not to make it seem too hard.

Well, the consequence is, that there are so many little things to go wrong—or at least grow different—that even brothers and sisters are very seldom exactly alike. Perhaps one is like the father and has brown eyes, and the other is like the mother and has grey.

They are sure to be rather like their father

and mother (a rabbit never has kittens), but also almost sure not to be exactly like.

So to begin with, you get small differences. Then for another reason, there were always a good many different places where an animal could live. Yet wherever a kind of beast lived, it could only go on if it could change itself from time to time. For the earth changed a good deal. For one or two hundred thousand years, one part of the earth would be very hot and dry ; then the sea would flow over that part again. Then later on there would be an Ice Age, with weather as cold as the North Pole all over the part of the world that had been hot and dry.

If animals were going to live through changes like that, they had to be ready to change, too, and to move about.

So now we have got two causes of animals being different. First, that because an animal is made of so many different little cells, even twin rabbits or kittens are not likely to be exactly alike. Then second, the heat and cold, or the wetness and dryness, of the places in which they live. For instance, Polar bears and seals are very good animals for living in wet cold places, and gazelles for living in hot dry ones.

The third thing that made changes in

animals, was that after a time, there were a great many creatures on the earth, and so there was a lot of crowding ; and it was often a very useful thing to be a little different to the other creatures. For instance it was a good thing to have a longer neck than anybody else, so that you could eat high twigs when the others had finished all the low ones.

Very soon creatures began to eat each other. I suppose they began with weak ones first, or ones that had died ; but very soon, in a time when food was scarce—(perhaps because an Ice Age was coming and it was getting very cold, or because that particular part of the world was drying up too much), then, when plants were scarce, animals began to fight and eat each other.

So that was a third thing which made animals change. They had to prevent other animals from eating them. Some animals only wanted to escape. You can think of gazelles and deer and horses and most sorts of bird. These creatures became swift, and had very quick eyes and ears, so that they could hear or see when their enemies were coming.

Some animals escaped by popping down into holes which they had dug, like rabbits, or marmots or chipmunks.

Some animals took to wearing armour, like armadillos or rhinoceroses, and some to being too prickly to touch.

Then creatures that ate meat, like wolves, found that if a lot of them worked together they could pull down and kill animals much bigger than themselves. And so wolves hunt in packs to this day. There is a little long-legged pig called a peccary, too, that always stays in packs, so that even tigers are afraid to attack it.

You can see that from these three things alone a great many very different and very curious animals might grow.

But there was still one more thing. For still we have thought of no reason why nightingales should have grown their lovely voices, or why so many sorts of animal have grown such lovely stripes, and spots, and bright colours. These things were useful in another way.

The peacock (who is a kind of pheasant) grows his tail, and the thrush learns to sing, so that the hen birds shall be willing to marry them. Luckily the hen birds seem to think just the same things charming that we do; and so the cock birds try which can sing most sweetly and look most beautiful to please the hens, and the hen marries the one that she likes the best.

So these are the four things that will change an animal, working on the tiny changes that make brothers and sisters have different coloured fur :

1. *The sort of place in which the animal lives* —Hot or cold, or wet or dry.
2. *Crowding*—So that it learns to eat something nobody else could get at before, or live upon something that nobody else knew was good for food.
3. *Fighting*—So that it grows teeth, and claws, or horns, or swift feet to run away.
4. *Courting*—So that the cock bird (or father animal) grows beautiful or clever to please the hen (or she animal) that he wants to marry.

But all the same, all these reasons don't seem to me to make up quite a whole answer. It seems hard to believe that some animals and birds did not grow either just to be beautiful or else as a joke. (Look at the frontispiece.)

Think of a wart-hog, which is simply frightfully ugly, and of a musk-ox, which always looks extremely cross and puzzled, and of toucans, that look as if they had put a small coal-scuttle on their heads. Think of the way

parrots shriek, and crocodiles leave their mouths open for hours after they have yawned. Think of ants all in armour, and smart striped wasps with stings and loud buzzing wings, and of painted butterflies, and glow-worms that carry a little green light in the dark.

However, these reasons seem to fit a good many sorts of animal. I mean, you can see that an animal that lived in such and such a country, which already had such and such other animals in it, would very likely grow to be like the particular kind you are thinking about. It seems queer to think that animals starving and eating each other, should have made so many beautiful different kinds of creature.

2

Do you remember that Chapter IV is nearly all about nerve threads and the brain, and how messages had to be taken from one part of the body to another?

A little girl of about seven called Judy, who had part of this chapter read to her by her teacher, seemed to think it was rather silly to need the nerves for taking messages. She said: '*Of course* the flippers knew when there was food coming, because they are part of the same creature as the tummy.'

So I would like to tell you what I told her (when the teacher let me interrupt), to explain about this, and to show that your hand or foot does not know of itself.

In the War everybody who was nursing the soldiers had to be taught one special thing. Suppose a soldier had had an operation, because his foot was so badly hurt that it could not be mended but had to be cut off. Well, of course he was given sleepy stuff to breathe so that he would not feel the pain.

When the soldier was put back to bed, if a nurse put a hot-water bottle by his other foot or by his side, she would have to take very great care not to have it too hot, and to wrap it up, because he would not know in the least if it was burning him. The sleepy stuff would have prevented his brain and nerves from taking any messages at all, neither useful ones about the hot bottle, or the useless ones about the pain of having his leg cut off.

I once saw a man who had had an operation on his throat. When he had been put back to bed a hot-water bottle had been put at his feet, and they were quite badly burnt from the heat of the hot-water bottle, and so afterwards he had to stay in bed because of that.

The sleepy stuff is breathed in through the

ill person's nose and mouth, and it does nothing to any part of the body except the nerves and brain, so this proves that feet and hands do not feel of themselves.

When Judy asked her question the teacher went on to read the sentence about the dog. It was this: 'Smell nerve says to the dog, "There's a delicious bit of meat close to me," and quick as winking brain flashes back to teeth and tongue and throat, "Snap it up and swallow it!"'

Two children seemed to think that 'quick as winking' meant no time at all, and asked if it would be as quick as lightning.

It would not. A message from the eyes or fingers of a person takes longer than a message from the eyes or nose of a dog, and messages take a different length of time from different parts of you.

Think of somebody writing on a typewriter or playing on a piano. Their fingers go very fast indeed. If you had to play a piano or write on a typewriter with your whole leg or foot, you could not do it nearly so quickly.

People do play the organ partly with their feet, but the foot part is always the slow part, because messages cannot go so quickly from the brain to the feet, as from the brain to the hands.

But messages go at a different pace in different people. I remember, when my children were young (about one or two years old), that when we were in a car or train I used to say to them: 'Look at that bird!' Now it takes a little while for the message from a small child's ear to get to its brain, and it takes a little while for the baby to turn its head: and by the time all that had been done, we had always either quite passed the bird, or it had flown away. Babies' telegraphs work very much slower than yours. But there is a difference in grown-up people, too, and sometimes a difference in the same person whether they are ill or well, wide awake or sleepy.

Before you are allowed to be an airman and fly an aeroplane, you have to go to a special doctor who finds out how fast your nerves work, because in the air, if a man saw danger and didn't quickly pull the right lever, everybody in the aeroplane might be killed. Quite a lot of people who would like to be airmen are not allowed to be because their nerves do not work quickly enough.

If you have got a baby friend, or a small sister or brother of one or two years old, you can try for yourself how slowly they understand and turn their head if you say: 'Look!

Look!' You can measure the time by counting: 'One, two, three.' But do not snatch the thing away, or it is rather an unkind experiment.

By the way, some people who are very clever in another way are very slow at this seeing and doing. So do not worry if you find that you, or someone you like, are slow at it. It has nothing to do with the part of your brain that understands history, or the sort of things that are written about in this book.

3

Another question that was asked was: 'Why do things hurt?'

The answer is that pain is a most useful danger signal, and that if a wild animal or a person could not feel pain he would probably soon die of poisoning or some wound or illness. Pain is a kind of danger signal that says: 'Don't!' or 'Look out!'

The man who had the operation to his throat, for instance, got burnt feet because he could not feel pain.

You and I rest our twisted ankles and the dog rests his cut paw, not because we are sensible and know that a hurt place must have time to mend, but because walking hurts. If it did not hurt, we should all forget and rush

about as usual. So the nerves keep reminding you that you must attend to whatever is wrong, and must give it time to heal before you use it again.

But, of course, pain can be a great nuisance.

4

Another question that was asked was : ' How do crabs breathe ? '

The answer is that water crabs—the sort you see at the seaside—have gills, and that land crabs which live in hot countries have small lungs.

5

Pamela wanted to know why life began in the water. I asked someone who knew more about these things than I did.

He answered that it was because creatures—whether they are made of flesh and bones or of jelly—are very watery themselves. He said that if I was thoroughly dried I should not be half the size or weight I am now. One of the chief things that skin is for, he went on, is to prevent you from drying up.

It is impossible for anything to live outside water or very wet mud unless it has a tough skin.

There are some simple creatures (germs) that do get dried and then float about in the air, but they cannot grow or eat until, and unless, they get blown on to something wet.

Also, of course, a thing could not stay in the air without wings, unless it was very small and light. So a thing that floated in the air would never get beyond the one cell size.

6

There seemed no place in the book to talk about fur and feathers; but I expect you will have noticed that none of the fish or reptiles have either. (Reptiles are such beasts as crocodiles, tortoises, lizards and snakes.)

But when you come to birds and such creatures as dogs and moles and guinea-pigs, very few of them are bare. The ones that are bare, like the elephant and rhinoceros, are creatures that live in very hot countries, and besides that their skin is terrifically thick.

Reptiles do not need fur or feathers because they are cold-blooded.

The reason why birds and mammals grew fur and feathers, was because they started having warm blood (which was convenient in many

ways, for instance, for moving quickly), and once they had warm blood they needed something to wrap themselves up in, or else they would be always having to look for food to keep themselves warm, and never stop eating, which would wear them out.

If you want to keep a hot-water bottle hot you put a cover on it or put it under the bed clothes; so as soon as they wanted their blood to be warmer than the air, creatures had to begin to grow fur and feathers to keep it from cooling.

7

Several of the children who had the book read to them, said different things about what is in it.

A little girl of about seven (it was Pamela, who had asked about living in water) made a very sensible remark. She said: 'Why, you were once like everything!'

That is nearly true. We were once like everything in our line. We were not like ants or bees ever. But I thought it was a good way of putting it, which I had not thought of.

A boy called Joe, who was eight, said that a grown-up person's heart, with its four rooms and its doors, was just like a house.

Another little girl felt very sorry that she had shed her fur before she was born; and when the teacher came to the part about the fur-coated creatures keeping their babies inside them until they had been growing for some time, she said: 'Yes, how nice! Then, if a lion ran after the mother, she wouldn't have to go hunting about for the baby.'

Some of the children wanted to know whether other mammals, such as tigers, were jellies before they were born. The answer is, yes, they were. Every creature has to act through the whole history up to the sort that it belongs to. If it is only going to grow into a dog-fish or a lamprey, it does not act through very much of it.

8

We have said a great deal in this book about animals being born, and very little about their dying, except when they died to be food for some other growing creature.

We also said a great deal about animals learning some new trick—growing long necks or so on—and very little about creatures that forgot the good tricks they had learnt.

But these things, dying and forgetting, happened too, often and often and often.

Some sort of forgetting is a pity, but some is needed for any sort of learning, and some sort of dying for being born.

It is rather fun to try and imagine animals with such faithful memories that they could not forget their old tricks, and who had not learnt that useful habit of not going on with anything that is not some use. You can imagine the sad life of a mole which still had eyes which got full of dirt, and still had long legs which got in its way when it was underground. Imagine too a woolly rhinoceros like the sort that came in the Ice Age, which lived in the tropics now and had not noticed the change in climate, and still kept his wool. Or you can imagine a cat that hated water, like all cats, but still had gills.

If an animal or a person kept all the things that had been useful to its grandfathers and grandmothers, and never forget anything, or shed anything, that poor creature—what with having gills and wings and flippers and one thing and another—would never get on and would be so tired in the end of growing up that it could not live at all. So forgetting is useful.

I wonder if you ever thought of the idea that dying is a very useful thing, too? It is a

very good job, not only that the brontosaurus and the tyrannosaurus (whose names mean 'thunder lizard' and 'tyrant lizard') are dead, but it is also a good thing that all kinds of quite harmless but very stupid creatures died to make room for their children, and their children's children's children. No one creature can learn more than to be better at one very tiny thing. It takes a whole row of creatures—waves and waves of parents and children, lasting thousands of years—to shed a tail or grow a new sort of tooth.

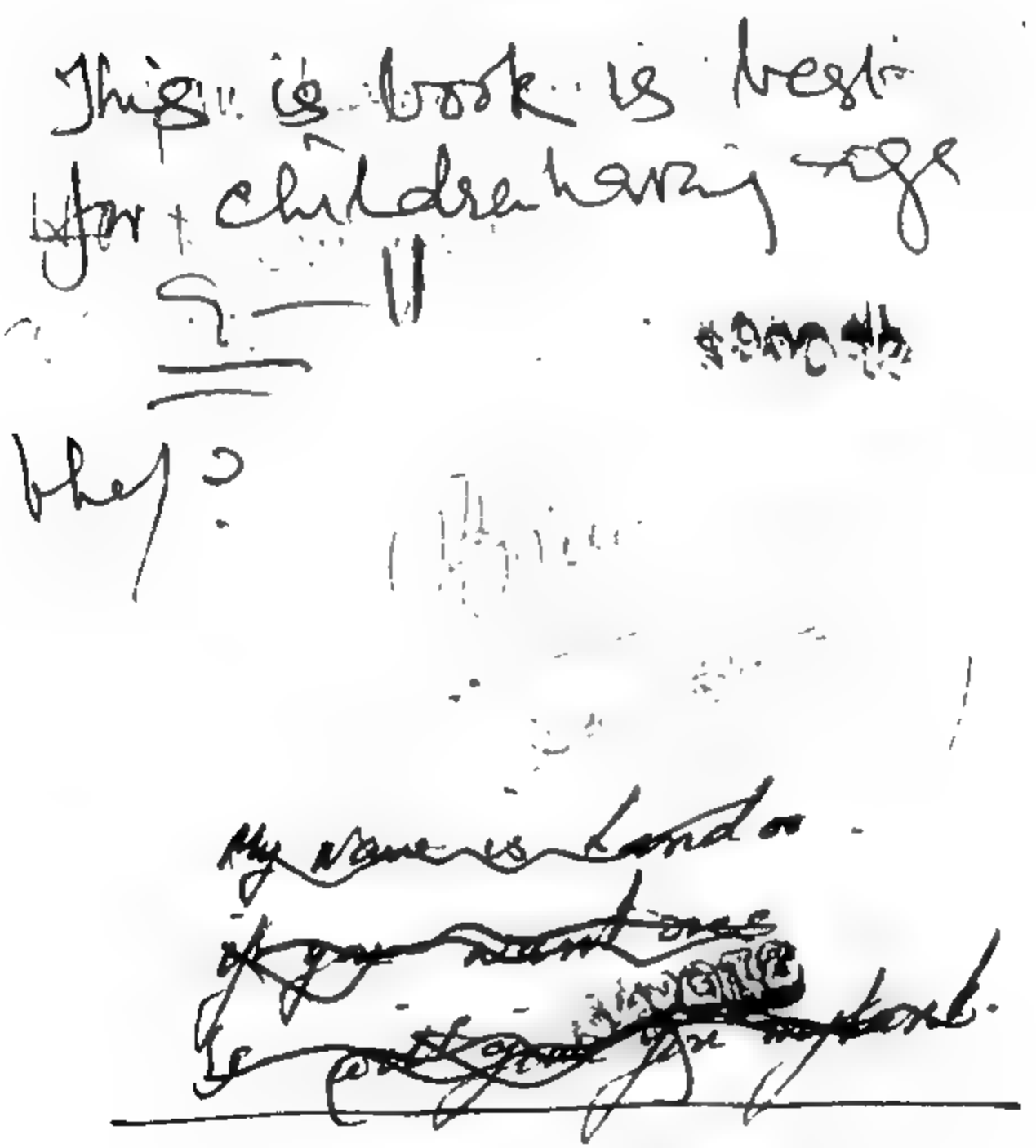
Every animal that dies or is killed, makes room for another young one. With luck the young one may begin where the old one left off. It is the same with people. With every new lot of children there is a new set of chances of something marvellous being found out.

It is certainly sad when an animal or a person dies without ever having had a chance. But when they have had a long life and learnt a lot, then it is not sad that they should make room for a new, young, strong person or creature.

If this were not true, the world would be rather a sad place, and it would make us unhappy to think of so many creatures dying, and of so many plants fading, for so many

hundreds and thousands of years. But if we think that each lot that dies makes room for a new lot, with a new chance and fresh strength, that can share the job of learning, then I don't think that it does seem sad.

THE END



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FOR TEACHERS OR PARENTS

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